

Attorney Docket No.: 57.0513 US PCT

Appln. No.: 10/542,654

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

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Listing of Claims

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1. (Cancelled).
2. (Currently amended) A system for maintaining zonal isolation in a wellbore, characterized in that said system comprises, within a pathway at a specific location along said wellbore, a sealing element to block said pathway, said sealing element being able to deform both during and after placement and wherein the sealing element is maintained under compression after completion of the placement, thereby urging the deformable sealing element into contact with less deformable material bounding the pathway so as to maintain a seal against fluid migration along the pathway, wherein the sealing element is connected to a fluid communication element adapted to supply pressurizing fluid after placement and thereby maintain pressure within at least part of the sealing element.
3. (Currently amended) The system of claim 1, wherein the sealing element is confined in a volume surrounded by materials of high Young's modulus, greater than 1000MPa, and the sealing element comprises a sealing material, which has a Young's modulus below 1000 MPa.

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4. (Currently amended) The system of claim ~~1~~ 2, wherein the sealing element comprises a sealing material in a solid state.

5. (Currently amended) The system of claim ~~1~~ 2, wherein the sealing element comprises a sealing material which approximates the behaviour of an elastic solid.

6. (Currently amended) The system of claim ~~1~~ 2, wherein the sealing element comprises a sealing material in a liquid state.

7. (Currently amended) The system of claim ~~1~~ 2, wherein the sealing element comprises a sealing material, said sealing material being a yield stress fluid.

8. (Previously presented) The system of claim 7, wherein the yield stress value of the sealing material is greater than 10 Pa.

9. (Original) The system of claim ~~1~~ 2, wherein the sealing material is visco-plastic.

10. (Original) The system of claim ~~1~~ 2, wherein the sealing material is visco-elastic.

11 - 12. (Cancelled).

13. (Currently amended) The system of claim ~~1~~ 2, wherein the sealing element comprises an inflatable membrane.

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14 - 15. (Cancelled).

16. (Currently amended) The system of claim 12, wherein the sealing element is able to deform for more than ~~7 days~~ 5 years after placement.

17. (Original) The system of claim ~~1~~ 2, wherein the sealing element is designed to deform for the planned life time of the well.

18. (Currently amended) The system of claim ~~1~~ 2, wherein formation surrounding the wellbore comprises at least a first layer and a second layer, said first layer being essentially impermeable and said second layer being permeable and wherein the sealing element is at least partially placed adjacent to the first layer.

19. (Cancelled).

20. (Previously presented) The system of claim 3, wherein the sealing element is a sealing ring, said sealing ring being placed in an volume formed by well tubing, formation surrounding the wellbore and cement injected into the wellbore.

21. (Previously presented) The system of claim 20, wherein the cement injected into the wellbore comprises a first sheath portion and a second sheath portion and wherein the sealing ring is contained between and contacts said first sheath portion and said second portion.

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22. (Previously presented) The system of claim 20, wherein the cement injected into the wellbore comprises material that expands after placement.

23. (Cancelled).

24. (Currently amended) The system of claim 1 2, wherein the average height of the sealing element, measured along the wellbore axis, is less than approximately 150 m.

25. (Original) The system of claim 24, wherein the average height of the sealing element, measured along the wellbore axis, is less than approximately 60 m.

26. (Original) The system of claim 25, wherein the average height of the sealing element, measured along the wellbore axis, is comprised between approximately 1 m and approximately 30 m.

27. (Currently amended) The system of claim 1 2, wherein the sealing element comprises a sealing material, which is sufficiently fluid prior to placement to be pumped or injected at a specific downhole location, and sets under pressure to a deformable solid or a yield stress fluid.

28. (Cancelled).

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29. (Previously presented) The system of claim 27 wherein said sealing material expands during solidification or gelation.

30. (Currently amended) The system of claim 3 57, wherein the sealing material is maintained under compression by cement sheath portions.

31. (Currently amended) The system of claim 3 57, wherein the sealing element is compressed by expanded parts of a well tube.

32. (Original) The system of claim 3, wherein the sealing element consists of a chemical compound that homogenously fills the volume.

33. (Original) The system of claim 2, wherein compression results from the hydrostatic pressure of the liquid/yield fluid that forms the sealing material.

34 - 36. (Cancelled).

37. (Previously presented) A method of maintaining zonal isolation in a wellbore, characterized in that it comprises the following steps:

placing a sealing element at a specific location along said wellbore;

allowing said sealing element to be able to deform both during and after placement; and

maintaining the sealing element under compression after completion of the placement by exerting pressure on the sealing element through a permanent fluid communication element.

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38 - 39. (Cancelled).

40. (Previously presented) A method of maintaining zonal isolation in a wellbore, characterized in that it comprises the following steps:

placing a sealing element at a specific location along said wellbore, said sealing element comprising a sealing material which is a liquid or a gel

allowing said sealing element to be able to deform both during and after placement;

activating said sealing material to transform to a solid or yield stress fluid, and

thereafter maintaining the sealing element under compression after completion of the placement,

wherein the activation is triggered by expansion of parts of a well tube crushing encapsulated components of the sealing material, by an external trigger, or by injection of an activator.

41. (Currently amended) The method of claim ~~36~~ 40, wherein there is a well tube within said well bore and the sealing element is placed on the outer surface of said well tube.

42. (Currently amended) The method of claim ~~36~~ 40, wherein the sealing element comprises an inflatable element, said inflatable element being inflated by a sealing material, in a liquid or gel state.

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43. (Currently amended) The method of claim ~~36~~ 40, wherein there is a well tube within said well bore and at least part of the sealing material is placed after placement of the well tube.

44. (Previously presented) The method of claim 43, wherein the sealing material is pumped from the surface through one or more ports in the well tube.

45. (Original) The method of claim 44, wherein the well tube comprises a valve, which is able to open or close said one or more ports.

46. (Previously presented) The method of claim ~~36~~ 37, wherein there is a well tube within said well bore and the sealing material is pumped from surface into the annulus between the well tube and the formation.

47. (Original) The method of claim 37, wherein the fluid communication element is a control line tube between surface and the sealing element.

48. (Currently amended) The method of claim ~~36~~ 40, wherein the sealing element is pumped as part of a fluid train from the surface through a well tubing into the annulus between the well tubing and the formation.

49. (Original) The method of claim 48, wherein the sealing element is placed using a delivery tube introduced into the well tube.

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50. (Currently amended) The method of claim ~~36~~ 37, wherein there is a well tube within said well bore and the sealing element comprises an inflatable element placed in the annulus between the well tube and the wellbore, independently of the well tube.

51. (Currently amended) The method of claim ~~36~~ 37, wherein the sealing element has an essentially full cylindrical or disk shape to seal the full cross-section of the well.

52. (Currently amended) The method of claim ~~36~~ 40, wherein an under-reaming is carried out and the sealing material is placed in the under-reamed section of the well.

53. (Cancelled).

54. (Currently Amended) Use of the system according to claim ~~1~~ 2 for plug and abandonment.

55. (Withdrawn) Wellbore fluid comprising crosslinkable polypropylene glycol adapted for injection in the well to cause the formation of a permanent barrier to isolate sections of the wellbore.

56. (Withdrawn) The wellbore fluid of claim 55 wherein the polypropylene glycol comprises epoxy groups as terminal groups .

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57. (Currently amended) ~~The system of claim 7~~ A system for maintaining zonal isolation in a wellbore, characterized in that said system comprises, within a pathway at a specific location along said wellbore, a sealing element to block said pathway, said sealing element being able to deform both during and after placement and wherein the sealing element is maintained under compression after completion of the placement, thereby urging the deformable sealing element into contact with less deformable material bounding the pathway so as to maintain a seal against fluid migration along the pathway, wherein the sealing element comprises a sealing material, said sealing material being a yield stress fluid and the stress value of the sealing material is greater than 600Pa.

58. (Cancelled).

59. (Previously presented) The method of claim 39 ~~40~~ wherein said sealing material is a liquid before activation.

60. (Previously presented) The method of claim 39 ~~40~~ wherein said sealing material is a gel before activation.

61. (Currently amended) The system of claim ~~4~~ 57, wherein the sealing element is able to deform for at least 5 years after placement.

62. (Cancelled).

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63. (Currently amended) Use of the method according to claim ~~36~~ 40 for plug and abandonment.

64. (Currently amended) The system of claim ~~1~~ 2, wherein said pathway is at least partially bounded by rock or cement.

65. (Currently amended) The method of claim ~~36~~ 40, wherein said pathway is at least partially bounded by rock or cement.

66. (New) The method of claim 40, wherein the sealing element is confined in a volume surrounded by materials of high Young's modulus, greater than 1000MPa

67. (New) The system of claim 57, wherein the sealing element is confined in a volume surrounded by materials of high Young's modulus, greater than 1000MPa.

68. (New) The system of claim 57, wherein the sealing element is confined in a volume formed by well tubing, formation surrounding the wellbore and cement injected into the wellbore.

69. (New) The system of claim 57, wherein the sealing material is sufficiently fluid prior to placement to be pumped or injected at a specific downhole location, and sets under pressure to a yield stress fluid.

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70. (New) Use of the system according to claim 57 for plug and abandonment.

71. (New) A system for maintaining zonal isolation in a wellbore, characterized in that said system comprises, within a pathway at a specific location along said wellbore, a sealing element to block said pathway, said sealing element being able to deform both during and after placement and wherein the sealing element is maintained under compression after completion of the placement, thereby urging the deformable sealing element into contact with less deformable material bounding the pathway so as to maintain a seal against fluid migration along the pathway, wherein the sealing element is composite and comprises a first material which is a yield stress fluid and forms a continuous phase and a second material which is solid and forms a discontinuous phase intermingled with the continuous phase first material.

72. (New) The system of claim 71, wherein the sealing element is confined in a volume surrounded by materials of high Young's modulus, greater than 1000MPa.

73. (New) The system of claim 71, wherein the sealing element is confined in a volume formed by well tubing, formation surrounding the wellbore and cement injected into the wellbore.

74. (New) The system of claim 71, wherein the yield stress value of the sealing material is greater than 10 Pa.

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75. (New) The system of claim 71, wherein the sealing material is sufficiently fluid prior to placement to be pumped or injected at a specific downhole location, and sets under pressure to a yield stress fluid.

76. (New) The system of claim 71, wherein the sealing element is able to deform for at least 5 years after placement.

77. (New) Use of the system according to claim 71 for plug and abandonment.